

Remarks

Favorable reconsideration of the application is requested in view of the above amendments and in light of the following remarks and discussion.

Claims 1-19 are pending in the application. Claims 1, 8 and 14 are amended.

In the Office Action the drawings are objected to. In response, as shown in the replacement drawing sheets Figure 1 is amended to include reference number 10. The specification is amended to include descriptions of steps S3 and S7 of Figure 2.

With respect to the objections to Figures 5A-C, 8A-D, 9A-E and 10A-D, color photographs are submitted herewith. It is submitted that color photographs are the only practical medium to intelligibly show features of the present invention, including the colors of the microfacets that correspond to the number of the selected cameras, as required by the Office Action.

For the above reasons it is requested that the objection to the drawings be withdrawn.

In the Office Action claims 14-19 are rejected under 35 U.S.C. § 101 as being directed to non-statutory subject matter. In response claim 14 is amended to recite that the computer program-product includes a computer storage medium configured to store program instructions. It is submitted that the amended claims recite program instructions embodied in computer readable media, in accordance with 35 U.S.C. § 101 and MPEP § 2106(IV)(B)(1)(a). It is therefore requested that the rejection of claims 14-19 under 35 U.S.C. § 101 be withdrawn.

Claims 1, 2, 5, 8, 9, 12, 14, 15 and 18 are rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,573,912 to Suzuki et al. (Suzuki) in view of U.S. Patent No. 5,936,626 to Beasley. Claims 13 and 19 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Suzuki in view of Beasley, and further in view of the publication to Neugebauer. Claims 3, 10 and 16 are rejected under 35 U.S.C. § 103(a) as being

unpatentable over Suzuki in view of Beasley, and further in view of U.S. Patent No. 6,313,841 to Ogata et al. Claims 4, 6, 7, 11 and 17 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Suzuki in view of Beasley, and further in view of U.S. Patent No. 6,118,452 to Gannett. It is requested that the rejections of the claims be withdrawn, and that the claims be allowed, for the following reasons.

The present invention, as set forth in independent claim 1, is directed to an image processing apparatus. Independent claim 1 recites a memory which stores first images obtained by photographing an object to be rendered from different photographing directions, and second images that pertain to geometry information of the object to be rendered. A geometrical shape model generation unit generates a geometrical shape model of the object to be rendered on the basis of the second images. A microfacet generation unit generates microfacets used to approximate a three-dimensional shape of the geometrical shape model. A billboard processing unit rotates the microfacets to make a predetermined angle with a view direction. A texture mapping unit generates a third image associated with the object to be rendered in correspondence with the view direction by selecting texture images for respective microfacets from the first images on the basis of the photographing directions and view direction, and by projecting the selected texture images onto the microfacets.

The claimed invention can provide numerous advantages. By way of specific non-limiting examples, because microfacets are used to approximate a three-dimensional shape of a model, and these microfacets are rotated to make a predetermined angle with a view direction, the three-dimensional shape of the model can be approximated from any desired viewing direction without requiring that depictions be taken of the model from any and all directions from which the model can be viewed.

Thus, the present invention recited in the claims approximates a three-dimensional shape by microfacets, executes a billboard process so that each microfacet maintains a

predetermined angle with a predetermined direction (e.g., view direction), and maps a suitable texture for each microfacet to provide a rendering image with a high quality.

It is submitted that neither Suzuki nor Beasley discloses or renders obvious the above-discussed claimed features recited in independent claim 1. Specifically, Suzuki discloses rendering images with a new viewpoint corresponding to a network, using a volume reconstructed, from a plurality of input images, by an interactive virtual telepresence method. Based on the Office Action's concession on page 5, lines 1-3, it is submitted that Suzuki does not disclose or render obvious the claimed features of rotating a plurality of microfacets used to approximate a three-dimensional shape of a model to make a predetermined angle with a view direction.

Page 5, lines 4-7, of the Office Action asserts that Beasley discloses "executing a billboard process that rotates the plurality of microfacets to make a predetermined angle with a view direction." However, it is submitted that column 7, lines 27-41 of Beasley states that a snapshot of a three dimensional model is turned into a low-number of polygon billboards to roughly approximate an image, that the three dimensional model is then rotated to a different angle of view, and that these steps are repeated until substantially all angles from which the object can be viewed in a three-dimensional volume are depicted in silhouette form. Thus, Beasley also does not disclose or render obvious the claimed features of rotating a plurality of microfacets used to approximate a three-dimensional shape of a model to make a predetermined angle with a view direction, as recited in independent claim 1. Therefore, Beasley is also unable to provide the above discussed advantages provided by the claimed invention, as Beasley requires that the silhouettes be taken of the model from any and all directions from which the object will be viewed.

Further, the claimed invention and Beasley are different in purpose and the way in which approximation by billboarding occurs. Due to these differences, in the present

invention, a plurality of microfacets is used to approximate a three-dimensional shape of an object to be rendered. At that time, the plurality of microfacets is rotated so as to form a predetermined angle with a predetermined direction (e.g., view direction). Therefore, the claimed invention includes a billboard processing unit which rotates the plurality of microfacets to make a predetermined angle with a view direction. Because a three-dimensional shape is approximated in this manner, depictions at all angles of view from which the object can be viewed in a three-dimensional volume are not needed. It is submitted that Beasley, Suzuki, and the other references of record do not disclose or render obvious these features.

Thus, it is submitted that none of Beasley, Suzuki, and the other references of record discloses or renders obvious approximating a three-dimensional shape by a plurality of microfacets or at what angle to control the plurality of microfacets used in the approximation. Thus, even if Beasley and Suzuki are combined as suggested in the Office Action, the combination merely provides a rendering method in which the polygons have been reduced due to rough approximation by a silhouette using billboard, when using a volume reconstructed by an interactive virtual telepresence method to render images with a new viewpoint.

For these reasons it is requested that the rejection of independent claim 1 be withdrawn and that independent claim 1 be allowed.

Independent claims 8 and 14 are allowable for reasons similar to those of independent claim 1. Therefore the allowance of new independent claims 8 and 14 is requested.

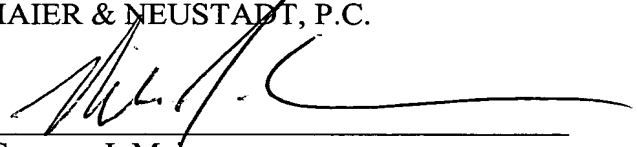
Claims 2-7, 9-13 and 15-19 are allowable for the same reasons as independent claims 1, 8 and 14 from which they depend, as well as for their own features. Thus, the allowance of dependent claims 2-7, 9-13 and 15-19 is requested.

Consequently, for the reasons discussed in detail above, no further issues are believed to be outstanding in the present application, and the present application is believed to be in condition for formal allowance. Therefore, a Notice of Allowance is earnestly solicited.

Should the Examiner deem that any further action is necessary to place this application in even better form for allowance, the Examiner is encouraged to contact the undersigned representative at the below listed telephone number.

Respectfully submitted,

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Amendments to the Drawings

Figures 1, 5A-C, 8A-D, 9A-E and 10A-D are amended as shown in the attached replacement drawing sheets. These drawings sheets, which include Figures 1, 5A-C, 8A-D, 9A-E and 10A-D, replace the original sheets including Figures 1, 5A-C, 8A-D, 9A-E and 10A-D.